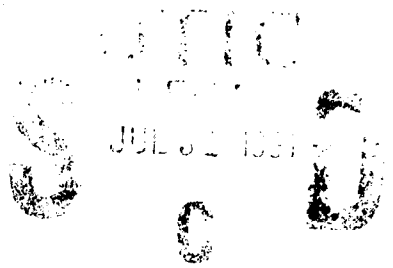


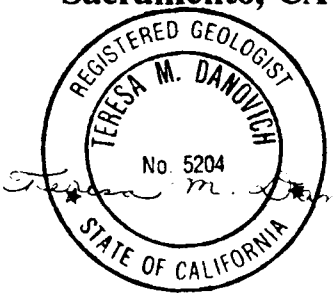
DRAFT FINAL

ADDENDUM TO THE QUALITY ASSURANCE PROJECT PLAN

SOIL VAPOR EXTRACTION TREATABILITY INVESTIGATION SITE S WITHIN OPERABLE UNIT D McCLELLAN AIR FORCE BASE

Prepared For

McClellan Air Force Base
Sacramento, CA



Prepared By

CH2M HILL

SAC28722.19.20

July 1991

PREFACE

CH2M HILL is a contractor for the RD/RA alternate technology program at the McClellan AFB in California. The specific technology addressed is soil vapor extraction. This document is a secondary document to the primary OUB RI/FS Report/ Proposal Plan. The work is being conducted under Air Force Contract No. F04699-90-0035, Delivery Order No. 5019.

Key CH2M HILL project personnel are:

Starr J. Dehn--Program manager
Gerald R. Tracy--Project manager
Joseph P. Danko--SVE technical coordinator
Donna Morgans--Data validation
Michael McCann--Data coordinator
David Myers--Field task leader
Kathy Brewer--Health and safety

CH2M HILL would like to acknowledge the cooperation of the McClellan AFB Office of Environmental Management for assistance in expediting this project. In particular, CH2M HILL acknowledges the assistance of Captain Fran Slavich.

The work discussed in this document is being conducted between June 1991 and April 1992.

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FIGURE

Section 1
INTRODUCTION

McClellan AFB has retained CH2M HILL to preform treatability testing of in situ soil vapor extraction (SVE) at Site S within Operable Unit D (O.U. D), located in the northwest portion of the base. This addendum presents the organization, objectives, functional activities, and quality assurance/quality control activities associated with the completion of the SVE treatability investigation.

This document is an addendum to the basewide Quality Assurance Project Plan (QAPP) issued for the McClellan AFB in May 1990. The addendum addresses quality assurance and quality control issues related to the completion of the in situ soil vapor extraction treatability investigation at Site S in O.U. D, McClellan AFB.

The organization of this addendum parallels that of the basewide QAPP, and wherever possible and appropriate, the addendum references the existing basewide QAPP. Specifically, this addendum includes only those portions of the existing QAPP that require modification in order to complete the following tasks:

- The collection, onsite field screening, and offsite analysis of soil samples as part of the treatability study site characterization
- The collection, onsite field analysis, and offsite laboratory analysis of canister samples as part of the air permeability test

An upcoming addendum to this SAP and QAPP, describing the objectives and approach in collection and analysis of samples during installation of pilot test wells, collection and analysis of SVE inlet and exhaust gas during the pilot test, selection and analysis of post-treatment soil sample, will be submitted for agency review during the design phase.

The SVE treatability investigation was initiated in April 1991. The SVE treatability investigation will include the following separate efforts:

- A site characterization study (June through August 1991)
- Design of a pilot-scale SVE system
- A second phase of site characterization during installation of the SVE pilot system (tentatively scheduled for June 1992)
- Operation of the SVE pilot system (tentatively scheduled for August 1992 through January 1993)

Presently, CH2M HILL is only under contract to perform the initial site characterization study and design the pilot-scale system.

Section 2
PROJECT DESCRIPTION

The United States Air Force (USAF) is conducting a remedial investigation/feasibility study at the McClellan Air Force Base to assess the nature and extent of contamination resulting from past practices and spills on the base and to plan for the remediation of identified areas of contamination. This QAPP addendum addresses activities related to the treatability investigation to assess the viability and effectiveness of in situ soil vapor extraction (SVE) as a tool for remediation at the McClellan AFB. The treatability investigation will include a site characterization study, an in situ air permeability test, and an SVE pilot test.

SITE BACKGROUND

A history of the McClellan AFB is presented in detail in the installation restoration program (IRP) QAPP (May 1990). A description of Site S in O.U. D, where the SVE treatability investigation will take place, is included in Section 1, Introduction, of the Sampling and Analytical Plan (SAP).

PROJECT OBJECTIVES

The objectives of the in situ SVE treatability investigation are to:

- Perform a characterization study of Site S at O.U. D for the SVE treatability investigation
- Design an SVE pilot system to determine the effectiveness and costs associated with the application of vapor extraction at McClellan AFB

PROJECT SCOPE

This QAPP addendum has been prepared specifically for the treatability investigation of in situ soil vapor extraction within Site S O.U. D, McClellan AFB. The addendum details the analytical methods that will be employed to meet the objectives of the treatability investigation. It will be used in conjunction with the SAP prepared for the treatability investigation and the existing basewide IRP QAPP (May 1990).

DATA COLLECTION AND USE

The primary use of data collected under this QAPP addendum will be in assessing the viability and effectiveness of SVE in providing remediation of VOC-contaminated vadose zone areas at McClellan AFB.

The sampling program has been divided into different phases, each having a specified data usage:

- Soil boring samples
- Air permeability testing
- SVE pilot testing

Table 1 lists the separate sampling phases of the treatability investigation and the planned data usage for each phase.

SAMPLING/MONITORING NETWORK DESIGN

Details of the sampling and monitoring network design are presented in the SAP for the treatability investigation. Table 2-1 presents the major elements of the program.

Table 2-1
Sampling Program Data Usage

Sampling Phase	Approximate Number of Samples	Planned Data Usage
1. Soil Borings (ground surface to 10 feet below the water table)	Split spoon soil samples will be collected at 2.5-foot intervals in up to five borings and at 5-foot intervals in the remaining borings. If contamination extends to the water table, soil borings will extend from the ground surface to approximately 10 feet below the water table (approximately 100 feet BGL). Onsite headspace analysis using an HNu or equivalent will be conducted on up to 300 split spoon samples. Up to 200 of the screened soil samples will also be sent offsite for VOC compound-specific analysis using analytical Methods 8010, MM8015, and 8240. Approximately 12 soil samples are planned to be sent to an offsite lab for priority pollutant analysis. Ten soil samples will be analyzed for total organic carbon (415.1) and up to 15 samples will be classified for grain size, percent saturation, permeability, and porosity.	Assessment of the geologic conditions and magnitude and extent of subsurface soil contamination. Onsite analyses to be used to select screen size and locations for SVE extraction wells and vacuum piezometers. Onsite screening results will also be used to determine which samples will be submitted for detailed laboratory analysis. Total petroleum hydrocarbon analysis (MM8015) will be used to differentiate between contaminant sources and to quantify the potential loading of nonhalogenated VOC to the SVE system. This information will be used in the planning and design of the SVE pilot test. Priority pollutant analyses will provide essential site characterization data. TOC, moisture content, porosity, permeability, and soil classification data will be used to assess SVE viability and for planning and design of the soil vapor extraction pilot test.
2. Air Permeability Testing	Up to 10 canister samples of soil gas from the air permeability tests will be collected for offsite VOC analysis using Method TO-14.	Assessment of the contaminants and contaminant concentrations in SVE offgas extracted during permeability testing. This information will be used in the planning and design of the SVE pilot test air treatment system.
3. SVE Pilot Test	Air samples from the SVE pilot wells, combined SVE exhaust, air treatment system exhaust, and soil gas monitoring probes will be analyzed onsite for total VOCs using an HNu or equivalent, and sampled for offsite VOC speciation using sample canisters. Air treatment exhaust will also be sampled for CO, CH_4, and HCl analysis. Selected field parameters including O_2, relative humidity, and temperature, will be measured in the SVE pilot wells and combined SVE exhaust during the pilot test. An onsite GC will also be considered for process monitoring in lieu of the HNu and some of the canister samples during operation of the SVE pilot test system. The methods selected for analysis will be described in more detail in an addendum to this QAPP and SAP submitted during the design phase.	Determination of the effectiveness and implementability of SVE for site remediation. Assessment and documentation of the effectiveness of SVE offgas treatment in meeting air quality standards.

Section 3
PROJECT ORGANIZATION AND RESPONSIBILITY

Overall project responsibilities for the basewide RI/FS are presented and described in the existing IRP QAPP. The specific responsibilities relating to the SVE treatability investigation are described below.

CH2M HILL has overall responsibility for all phases of the SVE treatability investigation. Some of the work will be subcontracted, including drilling analytical testing, and assistance with in situ permeability testing. CH2M HILL will perform project management and coordinate all subcontracted efforts, as well as prepare the design of the pilot-scale SVE system and all project reports related to the treatability investigation.

An organization chart identifying the individual responsibilities assigned for the project is presented in Figure 3-1.

PROJECT MANAGEMENT

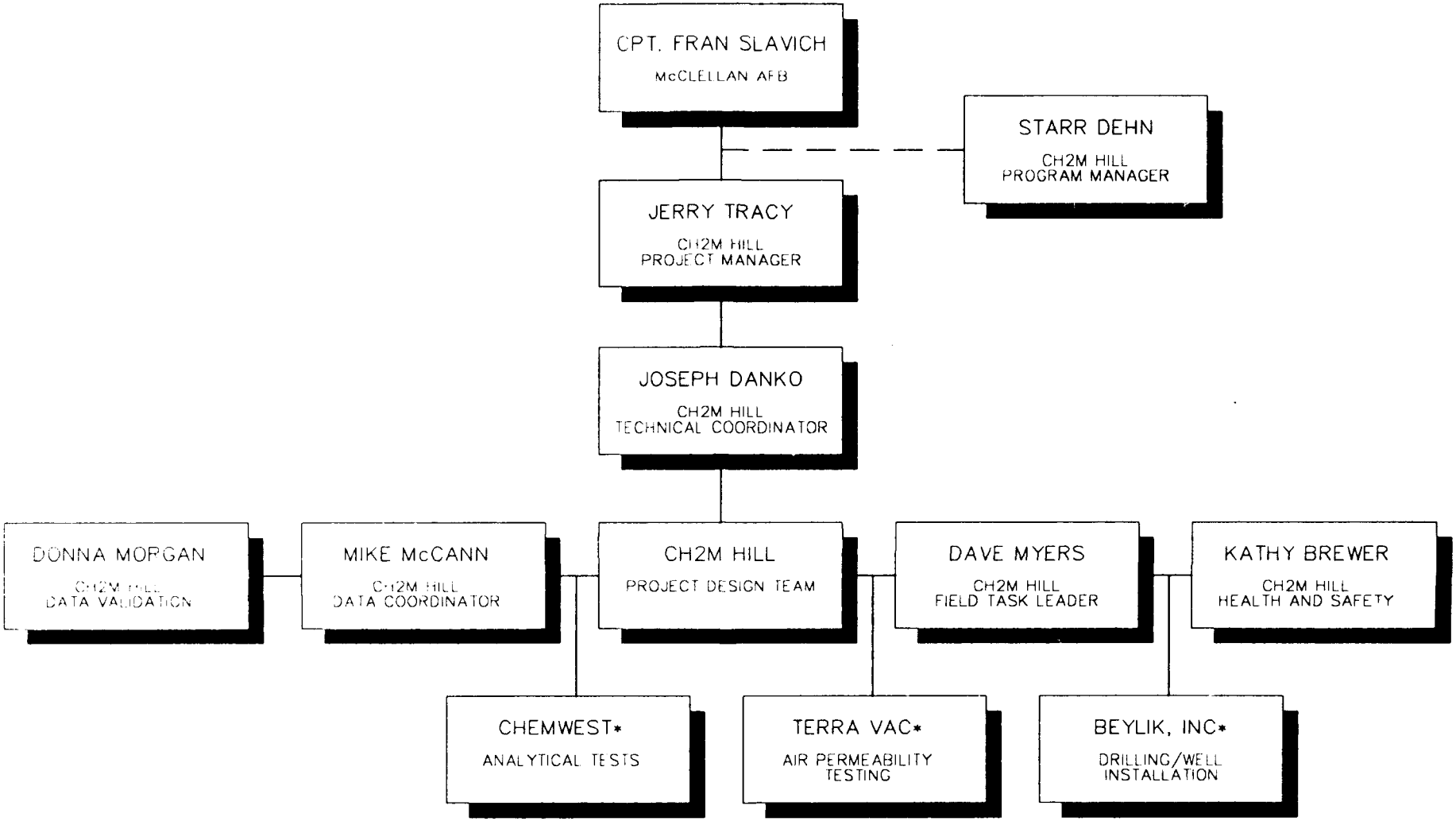
Mr. Starr Dehn is the Program Manager for all CH2M HILL work at McClellan AFB. He is responsible for the contractual aspects of all CH2M HILL projects at McClellan AFB, and provides coordination and continuity among the various projects. Mr. Dehn is located in CH2M HILL's Sacramento, California, office.

Mr. Jerry Tracy is the Project Manager for the Soil Vapor Extraction Treatability Investigation at Site S. He is responsible for managing the daily project activities and ensuring that the project objectives are met. Mr. Tracy is located in CH2M HILL's Corvallis, Oregon, office where the specific design activities will be conducted.

Mr. Joseph Danko is the Technical Coordinator for the project. He is responsible for coordinating the implementation of soil vapor extraction technology to the project-specific conditions. He is also responsible for coordinating analytical testing and in situ air permeability testing requirements and ensuring that the designated QA procedures are followed. Mr. Danko is located in CH2M HILL's Corvallis Oregon, office.

KEY STAFF

Ms. Susan McLaren is Data Manager for the project. She is responsible for developing the Data Management Plan and ensuring that the plan is consistent with the Air Force Installation Restoration Program Information Management System (IRPIMS). She is also responsible for coordinating the format of data deliverables from the subcontractors. Ms. McLaren is located in CH2M HILL's Corvallis, Oregon, office.



* SUBCONTRACTOR

FIGURE 3-1

PROJECT ORGANIZATION
SVE TREATABILITY INVESTIGATION
McCLELLAN AIR FORCE BASE

Mr. Dave Myers is the Field Task Leader. He will supervise CH2M HILL staff during the fieldwork and coordinate the activities of the field subcontractors. Mr. Myers will reside in Sacramento, California, during the fieldwork, and then return to his home base in Corvallis, Oregon.

Ms. Donna Morgan is the Data Validation Coordinator. She is responsible for reviewing the analytical data and validating that the data meets the QC objectives of the project. Her review and documentation of the analytical data occur before the data is released for use by other members of the project team. Ms. Morgan is located in CH2M HILL's Corvallis, Oregon, office.

Ms. Kathy Brewer is responsible for development of the health and safety plan amendment. She is also responsible for ensuring that the health and safety procedures are understood by the field task leader for implementation at the project site. Ms. Brewer is located in CH2M HILL's Corvallis, Oregon, office.

Mr. Mike McCann is the Data Coordinator for the project. He will be responsible for overseeing data entry and reporting operations and ensuring that only validated data is used for project decisionmaking. Mr. McCann is located in CH2M HILL's Corvallis, Oregon, office.

Section 4
QUALITY ASSURANCE OBJECTIVES

Quality assurance (QA) refers to the overall program for assuring that data of known quality are collected. Quality control (QC) refers to the specific routine procedures to help ensure that the quality of the measurements meet the specific QC level considered appropriate for the intended use of the data.

The general QA objectives for this project are to develop and implement procedures for obtaining and evaluating data of a known and acceptable quality so that it can be used to:

- Define the nature and extent (horizontal and vertical) of soil contamination at the study area
- Design and implement a pilot-scale SVE system
- Determine the effectiveness and implementability of SVE for site remediation
- The data should be of such quality that it can be used as part of the basewide Remedial Investigation/Feasibility Study. Specific procedures to be used for sampling, chain-of-custody, calibration, laboratory analysis, reporting, internal quality control, audits, preventive maintenance, and corrective actions are described in the IRP QAPP and in other sections of this QAPP and the SAP.

Specific QA objectives are:

1. Establish sampling and sample preparation techniques in such a manner that the analytical results are representative of the media and conditions being measured.
2. Analyze a sufficient number of laboratory duplicate samples to establish the sampling and sample preparation precision.
3. Collect and analyze a sufficient number of trip blank and field blank samples to evaluate the potential for contamination from sampling equipment and techniques.
4. Analyze a sufficient number of field blank, standard, duplicate, matrix spike, matrix spike duplicate, and check samples internally within the laboratory to effectively evaluate results against numerical QA goals established for precision and accuracy.

Data quality is assessed in terms of representativeness, comparability, precision, accuracy, and completeness of the data. These are discussed in the IRP QAPP, as identified in Section 4, Item--Data Quality Objectives, of the final copy of the QAPP.

DATA QUALITY OBJECTIVES

The data collected here will be used primarily for a treatability investigation. The data quality objectives (DQOs) described herein have been developed around the data use specific to the treatability investigation as described in the data collection and use subsection.

Table 4-1 presents the DQOs developed for the treatability investigation. This table correlates data use with the required degree of analytical sophistication. This approach is based on the generalized data quality objectives presented by the United States Environmental Protection Agency (EPA) in *Data Quality Objectives for Remedial Response Activities*, EPA 540/G-87/003A, March 1987. Five levels of data quality are available ranging from Level I, Field Screening, to Level V, Contract Laboratory Program (CLP) Special Analytical Services. For the treatability investigation, three analysis levels will be utilized: Level I, Field Screening, Level III, Non-CLP Standard Analysis, and Level IV, CLP Routine Analytical Services.

Table 4-2 presents the number of samples, analytical methods, and the type and number of QC samples planned for the treatability investigation. Method detection limits for each of the compounds of concern have been included in Section 3 of the SAP.

QUALITY CONTROL CRITERIA

Specific procedures for assessing precision, accuracy, completeness, representativeness, and comparability are presented in the IRP QAPP. The actual compounds to be used in evaluating the data precision, accuracy, and representativeness will be selected from the most prevalent compounds detected with each analytical method. This selection will be made during the data validation process.

QA procedures for the onsite headspace analysis field screening techniques are presented in the SAP for this treatability investigation. Additional procedures to be used for sampling, chain-of-custody, calibration, laboratory analysis, reporting, quality control, audits, preventative maintenance, and corrective actions are described in the SAP or in other sections of this QAPP addendum.

Table 4-2
Characterization Sampling and A

Sample Matrix	Field Parameter	Laboratory Parameter	Analysis Level	Samples			Duplicates	
				No.	Frequency	Total	No.	Frequency
Soil Boring Samples								
Soil	HNu or equivalent	N/A	I	300	1	300		
	N/A	SW 8240	IV	50	1	50	5	1
		MM SW 8015	IV	40	1	40	5	1
		SW 8010	IV	100	1	100	10	1
		PP	IV	7	1	7	1	1
	Dry sieve	N/A	I	30	1	30		
	N/A	TOC 415.1	III	10	1	10		
	N/A	Grain size distribution, porosity, permeability, and percent saturation	III	12	1	12		
Air Permeability Test Samples								
Air	N/A	Modified TO-14	III	4	1	4	1	1
SVE Pilot Test Sampling and Analysis Program[c]								
Air	HNu	N/A	I	6	78	468		
	O_2	N/A	I	6	26	156		
	Relative humidity	N/A	I	6	26	156		
	Temperature	N/A	I	6	26	156		
	N/A	TO-14	III	6	3	18	1	3
	N/A	CO	III	1	4	4	1	4
	N/A	HCl	III	1	4	4	1	4

[a]Field blanks will be collected at a 5 percent frequency. One equipment blank will also be collected and analyzed for each analytical para
[b]Trip blanks will be submitted at a one-per-shipment rate for analysis.
[c]Preliminary estimate. This phase will be further developed and detailed in an Addendum to this QAPP submittal during the design phase

Notes:
MM 8015 = Total petroleum hydrocarbons; modification as described in Section 8 of this QAPP Addendum.
PP = Analyzed for volatile compounds (SW 8240), base neutral and acid-extractable organic compounds (SW 8270), metals (
cyanide (SW 9010).
Sample numbers are approximate; actual number of samples will be determined in the field.
SVE pilot test sample numbers are based on a 6-month pilot test.

ble 4-2
›ling and Analysis Program

ıplicates		Field Blanks[a]			Trip Blanks[b]			Matrix Spike Duplicates			
·equency	Total	No.	Frequency	Total	No.	Frequency	Total	No.	Frequency	Total	Total
											300
1	5	3	1	3	5	1	5	5	1	5	68
1	5	2	1	2	4	1	4	5	1	5	56
1	10	3	1	3	10	1	10	10	1	10	133
1	1	1	1	1				1	1	1	10
											30
		1	1	1				1	1	1	12
											12
1	1	1	1	1							6
											468
											156
											156
											156
3	3	2	1	2				2	1	2	25
4	4	1	1	1							9
4	4	1	1	1				1	1	1	10

vtical parameter.

:sign phase.

). metals (EPA 200 series), dibenzo-p-dioxins and dibenzofurans (SW 8280), organochlorine pesticides and PCBs (SW 8080), and

Table 4-1
Data Quality Objectives

Analytical Description	Data Usage	Soil Borings	Air Permeability Test	SVE Pilot Test
Level I--Field Screening (nonspecific total VOC measurements)	Assessment of soil contamination; aid in test well screen placement; qualitative evaluation of SVE effectiveness during pilot test.	Field measurement of total VOCs on all split-spoon sampling.	None.	Field measurement of total VOCs, O_2, and CO_2 on air samples from SVE test wells, combined SVE stream, soil gas probes, and air treatment exhaust.
Level II--Field GC/Mobile Laboratory (speciation of indicator compounds)	None.	None.	None.	None.
Level III--Non-CLP Laboratory Analysis	Magnitude and extent of subsurface soil contamination; assessment of soil gas contaminant levels during in situ permeability test; evaluation of SVE effectiveness; documentation of air treatment.	EPA 8240 (GC/MS for VOCs) performed on selected soil samples; Method 8010 for target VOCs performed on selected soil samples; Modified Method 8015 for total petroleum hydrocarbons on designated samples; priority pollutant analysis. Total organic carbon (TOC) by 415.1, moisture, and soil classification performed on designated samples.	EPA TO-14 analysis performed on soil vapor samples collected during air permeability testing.	EPA TO-14 analysis performed on vapor samples collected from test wells, combined SVE stream, and treated offgas. O_2, CO_2, CH_4, and HCl analysis on all samples during pilot testing.
Level IV--CLP Routine Analytical Services	None.	None.	None.	None.
Level V--CLP Special Analytical Services	None.	None.	None.	None.

The QC samples to be collected as part of this field effort include field duplicates, matrix spike duplicates, equipment blanks, field blanks, and trip blanks collected for all samples submitted for offsite analysis except for soil physical testing. The proposed sampling frequency for the treatability investigation is included for each sample matrix in Table 4-2.

Section 5
FIELD WORK AND SAMPLING PROCEDURES

Details of field work and sampling procedures for the SVE treatability investigation at Site S, O.U. D of McClellan AFB are presented and described in the IRP QAPP (May 1990) and in the SAP for this work.

SAMPLING AND ANALYSIS

A summary of the sampling and analysis program to be carried out as part of the SVE treatability investigation at the McClellan AFB was presented in Table 4-2. Detailed descriptions of the soil boring and air permeability testing programs are presented in the SAP. Analyte lists for all of the identified analytical methods except Modified 8015 and TO-14 are presented in the IRP QAPP. The analyte list for TO-14 is presented in Section 8 of this addendum.

Up to 300 samples will be screened onsite using an HNu or equivalent organic vapor analyzing instrument. Samples will be selected for offsite analysis in accordance with the guidelines shown in Table 5-1.

Table 5-1
Guidelines for Selecting Samples for Fixed Laboratory Analysis

Analysis	Criteria
8240 or 8010	Obtain a sample every 20 to 25 feet vertically to provide vertical characterization of VOCs from waste pit to the water table. In addition, select the most contaminated sample from each separate lithologic zone encountered (i.e., less permeable silt to more permeable poorly graded fine sand) as determined by onsite HNu screening.
PP Scan (includes 8240, 8270, 8280, 8080, 9010, 200 Series)	Obtain one sample from the waste pit at each boring to analyze for semivolatiles, pesticides, PCBs, dioxins, metals, and cyanide. Also, obtain additional random samples below the pit to characterize the extent of migration of priority pollutants below the pit, particularly semivolatiles, which impact the fate and transport of VOCs.
Modified Method 8015	Obtain approximately four samples per borehole from the waste pit to the water table to vertically characterize TPH as gasoline and as diesel. High volatility short chain hydrocarbons affect Btu content of extracted off gas and hence the selection of emission control equipment for the pilot test. Extractable TPH affect the fate and transport of VOCs and the quantity of extractable TPH impacts the amount of biodegradation that could occur.
TOC 415.1	One per borehole, mainly in the waste pits to identify total organic carbon, which affects the fate and transport of VOCs.

Section 6
SAMPLE CUSTODY

Sample custody procedures to be implemented during the SVE treatability investigation at Site S, O.U. D are presented and described in the SAP and the IRP QAPP (May 1990). A separate onsite sample log book will be maintained at the field office for samples analyzed onsite using a field screening technique for total VOCs.

Section 7
CALIBRATION PROCEDURES AND FREQUENCY

The calibration procedures to be used for field and laboratory equipment during the SVE treatability investigation at Site S, O.U. D are presented in the IRP QAPP (May 1990). All analytical instruments are to be calibrated according to manufacturers' recommendations and method requirements. Laboratory calibration procedures and frequencies are included in analytical standard operating procedures (SOPs) for analytical levels prescribed for this project.

Section 8
ANALYTICAL PROCEDURES

A majority of the analytical methodology and calibration procedures that will be used in the analysis of samples generated during the SVE treatability investigation are described in the IRP QAPP (May 1990). Additional methods not included in the IRP QAPP are described briefly below. The additional methods include identification of VOCs from canister air sampling, Method TO-14, and total organic carbon (EPA 415.1). The procedures used for Modified Method 8015 are also described below.

The laboratory methods or SOPs identified in here and the IRP QAPP were published in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW846*, EPA, Third Edition, revised November 1986; *Methods for Analysis of Water and Wastes*, EPA-600/4-79-020, 1979; Title 22, Article 11 of the California Administrative Code, "Criteria for Identification of Hazardous and Extremely Hazardous Wastes;" "Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act," 40 CFR, Part 136, *Federal Register* 49 (209), 26 October 1984; and the *Compendium of Methods for the Determination of Toxic Compounds in Ambient Air*, EPA-600/4-84-041, April 1984.

TO-14--DETERMINATION OF VOCS AND TPH USING SUMMA PASSIVATED CANISTERS AND GC ANALYSIS

Upon arrival at the contracted laboratory, the canister sample information is recorded from the Chain Of Custody form and logged into the laboratory sample tracking system. To analyze a canister sample, the container is pressurized to a known pressure and the pressure recorded. This pressure value is again used to calculate the final sample concentration after analysis.

The pressurized canister is then attached to the analytical instrument. The instrument extracts a known volume of air from the canister to be analyzed. The air is then passed through a drier to remove entrained moisture and concentrated by collection in a cryogenically cooled trap. The trap temperature is then raised and the collected compounds are volatilized back into the gas phase and directed to a high resolution gas Chromatographic analytical instrument. The individual species are separated on the GC column, identified and quantified using a mass spectrometer (MS-specific detector) operated in the full scan mode.

For the purposes of this study, the standard list of TO-14 compounds plus acetone and MIBK will be evaluated. Total petroleum hydrocarbons (TPH) will also be evaluated and reported for each canister. The GC/MS scan mode evaluations will be reported in their entirety, including any nontarget list compounds detected and up to 10 TICs. All

samples collected will be analyzed for TPH by summation of the integrated area on the chromatogram in the TPH region (C4 to C12) and quantified and reported as heptane (C7). The quantification is based on a heptane standard calibrant gas.

The target compound list for full scan GC/MS volatile TO-14 analyses is presented in Table 8-1. The listed compounds have a method detection limit (MDL) of approximately 1 part per billion (ppb) volume basis with the exception of acetone at approximately 10 ppbv.

EPA 415.1--TOTAL ORGANIC CARBON (TOC)

Determination of TOC by EPA 415.1 involves converting the organics to carbon dioxide (CO_2) by catalytic combustion or wet chemical oxidation. The CO_2 formed can be measured directly by an infrared detector or converted to methane (CH_4) and measured by a flame ionization detector. The amount of CO_2 or CH_4 is directly proportional to the concentration of carbonaceous material in the sample.

MODIFIED 8015--TOTAL PETROLEUM HYDROCARBONS

1. TOTAL PETROLEUM HYDROCARBONS (TPH) EXTRACTABLES BY GC-FID

A 30-gram, or other appropriate aliquot of soil, is mixed with 30 grams of washed sodium sulfate. 100 mls of 2+1 methylene chloride/acetone is added to the soil and placed on a mechanical shaker for 1 hour. The solvent is decanted off and the process is repeated with an additional 50 ml of methylene chloride/acetone. The combined solvent extracts are filtered through sodium sulfate and the extract is concentrated to a 3 ml final volume.

An appropriate volume of the sample extract is injected into a gas chromatograph equipped with a flame ionization detector (FID), a split/splitless capillary injector (operated in the splitless mode), and a fused silica capillary column. The TPH fraction is quantitated as gasoline and/or No. 2 diesel fuel (and/or different petroleum hydrocarbon fuel types if requested, such as JP-4 jet fuel) based on relative retention times and examination of the elution profile. The TPH fraction quantitation is based on chromatographic peak areas against a multipoint standard curve.

Table 8-1 TO-14 Target Analyte List	
Freon 12	1,1,2-Trichloroethane
Freon 114	Tetrachloroethane
Chloromethane	Ethylene dibromide
Vinyl chloride	Chlorobenzene
Bromomethane	Ethyl benzene
Chlorethane	m,p-Xylene
Freon 11	o-Xylene
1,1-Dichloroethene	Styrene
Freon 113	1,1,2,2-Tetrachloroethane
Methylene chloride	1,3,5-Trimethylbenzene
1,1-Dichloroethane	1,2,4-Trimethylbenzene
cis-1,2-Dichloroethene	3-Dichlorobenzene
Chloroform	1,4-Dichlorobenzene
1,1,1-Trichloroethane	Chlorotoluene
Carbon Tetrachloride	1,2-Dichlorobenzene
Benzene	1,2,4-Trichlorobenzene
1,2-Dichloroethane	trans-1,2-Dichloroethene
trans-1,3-Dichloropropane	Acetone
Toluene	4-methyl,2-pentanone (MIBK)
cis-1,3-Dichloropropene	Total petroleum hydrocarbons

2. TOTAL PETROLEUM HYDROCARBONS BY PURGE AND TRAP AND GC-FID

DHS Method--Luft Field Manual. A 10-gram, or other appropriate aliquot of soil, is weighed into a clean VOA vial. Soils received in brass core tubes are sampled by discarding two 5 centimeters of soil from each end of the tubes (this is done to reduce the possibility of analyzing a portion of soil that has been exposed to sampling technique contamination). Equal aliquots of soil are then removed from each end of the tube and combined in the VOA vial. A 10-ml, or other appropriate volume of methanol, is added to the soil and the soil is shaken with the solvent. A 100 ul of the extract, or a reduced aliquot or volume of suitable dilution, is injected into 5 ml of laboratory blank water. The sample is purged on a suitable purge and trap system with helium. The purged sample is analyzed on a gas chromatograph equipped with a flame ionization detector (FID). A fused silica megabore column is used to separate the compounds.

3. BTEX (BENZENE, TOLUENE, ETHYL BENZENE, AND XYLENES) BY PURGE AND TRAP AND GC-PID

A 10-gram, or other appropriate aliquot of soil, is weighed into a clean VOA vial. Soils received in brass core tubes are sampled by discarding two 5 centimeters of soil from each end of the tubes (this is done to reduce the possibility of analyzing a portion of soil that has been exposed to sampling technique contamination). Equal aliquots of soil are then removed from each end of the tube and combined in the VOA vial. A 10-ml, or other appropriate volume of methanol, is added to the soil and the soil is shaken with the solvent. A 100 ul of the extract, or a reduced aliquot or volume of a suitable dilution, is injected into 5 ml of laboratory blank water. The sample is purged on a suitable purge and trap system with helium. The purged sample is analyzed on a gas chromatograph equipped with a photoionization detector (PID). A fused silica megabore column is used to separate the compounds.

Section 9
DATA REDUCTION VALIDATION AND REPORTING

In a project such as the soil vapor extraction investigation, information flow from the field and laboratory to those persons involved in project decisionmaking is critical. A data management system assists in this process by providing a means of tracking, cataloging, and organizing information. Such a system includes hardware and software for data handling (the data base), data management protocols such as chain-of-custody and QA/QC validation, and trained personnel to keep the system updated and operational. The primary objective of a data management system is to provide the user with data sets that have been verified and are internally consistent. These data can then be used for data analysis, statistics, plotting, etc.

There are two groups of data user's for this project: the Air Force personnel responsible for the Installation Restoration Program Information Management System (IRPIMS) and the CH2M HILL project team. IRPIMS requires that certain data be made available to the Air Force in a format compatible with their data base, while the project team requires that a subset of the IRPIMS data (namely sample and analysis information) be available in a system that can support data queries, reports, and graphics.

To satisfy the data needs of both sets of users, two data management tools will be used on this project. The IRPIMS Contractor Data Loading Tool will be used to prepare ASCII files in the correct format for the Air Force data base. The data delivery schedule and valid values lists in the IRPIMS Data Loading Handbook (Version 2.2) will be followed. Once these files are prepared, they will be used to load data into a Paradox-based data base designed for environmental investigations. This data base will be used by the CH2M HILL project team to support data analysis activities.

REDUCTION

Data reduction will be performed to determine the representativeness of the data and to validate laboratory quality control. The information generated by the data reduction step will be used in the interpretation of the data.

VALIDATION

Data validation involves a review of the laboratory-provided QC data and the raw data in order to identify any qualitative, unreliable, or invalid laboratory measurements. As a result, it will be possible to determine which samples, if any, are related to out-of-control laboratory QC samples. Laboratory data will be screened for inclusion of and frequency of the necessary QC supporting information such as detection limit

verification, initial calibration, continuing calibration, duplicates, spikes, and reagent blanks. QC supporting information will be screened to determine whether any data is outside established control limits, and if out-of-control data is discovered, appropriate corrective action will be determined based upon QC criteria for precision, accuracy, and completeness in the IRP QAPP. Any out-of-control data without appropriate corrective action will be cause to qualify the affected measurement data.

REPORTING

Data and information generated during the SVE treatability investigation will be summarized in a site characterization technical memorandum submitted to the McClellan AFB project manager. The information to be included in the memorandum is identified in the treatability investigation work plan.

Section 10
INTERNAL QUALITY CONTROL

The analysis of internal QC samples helps to monitor and document the performance of sampling and analysis activities. The documentation of QC provides a means for establishing the quality of data produced by the project. Both field-generated and laboratory QC samples will be utilized during the SVE treatability investigation.

The frequency of QC sample collection and data acceptance criteria are project-specific. The following field-generated QC samples are planned as part of the SVE treatability investigation at Site S, O.U. D:

- Duplicate samples: 1 in 10 samples for compound-specific soil samples (EPA 8010, modified 8015, 8240, 415.1, and priority pollutant analyses) and all canister air samples (TO-14)

- Matrix spike duplicates: 1 in 10 samples for compound-specific soil samples and all canister air samples

- Field blanks: 1 in 20 samples for compound-specific soil samples

- Equipment blanks: one sample per analytical matrix (e.g., one sample for 8240, one sample for 8010, etc.) for compound-specific soil samples

- Trip blanks: one sample per shipment of VOA samples (i e., 8010, MM8015, and 8240) for compound-specific soil samples

A description of the laboratory QC samples to be analyzed and additional information on the field-generated QC sample are provided in the IRP QAPP (May 1990). The analytical method SOPs also contain information regarding the frequency and acceptance of QC samples.

Section 11
PERFORMANCE AND SYSTEM AUDITS

Performance and system audits are independent assessments of sample collection and analysis procedures. Audit results can be used to evaluate a project's ability to meet data quality objectives, satisfy quality control criteria, and identify areas requiring corrective action.

CH2M HILL laboratory personnel regularly undergo standard procedural audits in order to ensure understanding and compliance of specified operating protocol. The audits include checks of proper documentation, chain-of-custody procedures, and QA/QC procedures.

No field audits are planned as part of the SVE treatability investigation.

Section 12
PREVENTATIVE MAINTENANCE

Preventative maintenance procedures help to maintain project and laboratory schedules through equipment readiness. Maintenance will be performed on all field and laboratory equipment according to the directions and frequency identified by the instrument manufacturers. Dated and signed instrument logbooks describing and documenting scheduled inspections, routine maintenance, and major repairs will be maintained for all instruments.

Maintenance responsibilities for laboratory instruments are assigned to the respective laboratory managers. Maintenance of field equipment is the responsibility of the project manager and the field team leader. The field team is responsible for checking the equipment prior to use and reporting any problems to the field task leader.

Section 13
DATA ASSESSMENT PROCEDURES

The assessment of data quality is necessary to ensure that the QA objectives for the sampling and analysis program are being met. The data assessment procedures for the SVE treatability investigation will include field procedures and laboratory procedures. They are discussed separately below.

FIELD PROCEDURES

Since field analyses generally do not involve samples that are retained for reanalysis, the primary QA/QC objective is to obtain reproducible measurements with a degree of precision consistent with the limits of the field instrument.

Quality control procedures for field instruments will be limited to verifying that the reproducibility of measurements are within 10 percent by taking multiple readings and periodically conducting instrument calibration checks (a minimum of twice daily). All field data sheets and notebooks used for calculating results and documenting calibration will be retained.

LABORATORY PROCEDURES

Data quality assessment for the analytical laboratory will be based on data precision, accuracy, and completeness. The calculation and application of these parameters is presented in the IRP QAPP (May 1990).

Section 14
CORRECTIVE ACTION

Corrective action procedures are required as the result of audited or self-identified nonconformance with predetermined QA/QC criteria or procedures established for this project. In the event that quality assurance is not met, action will be taken to correct the problem. Corrective action for laboratory problems (e.g., instrument operating ranges or calibrations) is the responsibility of the laboratory, including the lead analyst and the laboratory manager. The project manager and field team leader are responsible for all other corrective actions. Any corrective actions taken during the course of the SVE treatability investigation will be documented.

Section 15
QUALITY ASSURANCE REPORTS

No separate QA reports for this project are anticipated. The technical memoranda that present the findings of the site characterization and pilot test phases of the work will contain separate QA sections that summarize data quality information collected during the project.